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09/675,023	09/28/2000	Richard S. Burton	60944.3300	7669

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EXAMINER

LEE, HSIEN MING

ART UNIT

PAPER NUMBER

2823

DATE MAILED: 07/30/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/675,023

Applicant(s)

BURTON ET AL.

Examiner

Hsien-Ming Lee

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 23 June 2003.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-11, 14-21, 23-62 and 64-68 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☐ Claim(s) 1-11, 14-21, 23-62 and 64-68 is/are rejected.
- 7) ☒ Claim(s) 28, 29, 57, 59, 64, 66, 67 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____
- 4) ☐ Interview Summary (PTO-413) Paper No(s) _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

DETAILED ACTION

Remarks

1. The Final rejection as set forth in the previous Office action is withdrawn.
2. Applicant's cancellation to claims 12, 13 and 63 is acknowledged. Claims 1-11, 14-21, 23-62 and 64-68 are pending in the application.
3. The indication of allowable subject matters is withdrawn in light of newly discovered prior art.

Claim Objections

4. Claims 57 and 59 are objected to because of the following informalities: editorial error.
Claim 57, line 1 and claim 59, line 1, "[t] ohmic contact" should be – [t] **ohmic** contact -
-. (Emphasis added)
Claim 29, line 1 and claim 30, line 1, "[t]he ohmic contact according to claim 1" should
be – [t]he **method** according to claim 1 --.
Claim 28, line 1, "[t]he ohmic according to claim 21" should be -- "[t]he **ohmic contact**
according to claim 21 --.
Claim 64, line 1, "[t]he ohmic contact of claim 36" should be –[t]he **method according**
to claim 36 --.
Claim 66, line 1, "[t]he method of claim 21" should be – [t]he **ohmic contact** of claim 21
--.
Claim 67, line 1, "[t]he method of claim 34" should be – [t]he **ohmic contact** of claim 34
--. Appropriate correction is required.

Claim Rejections - 35 USC § 112

5. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

6. Claims 1, 21, 34, 36, 43, 44 and 61 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

The limitation “ said refractory layer is **substantially** free of gold” renders indefinite because the specification lacked some standard for measuring the degree intended. (Emphasis added) See M.P.E.P. 2173.05(b), F.

Claim Rejections - 35 USC § 102

7. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

8. Claims 1, 2, 7, 8, 14-21, 23, 27-29, 30-32, 34, 43, 45-47, 61 and 65-67 are rejected under 35 U.S.C. 102(e) as being anticipated by Burton et al. (US 6,573,599).

In re claims 1, 2, 7, 8, 14-20, 29, 30, 34, 43, 46, 47, 65 and 67, Burton et al., in Figs. 10-13 and related text, expressly teach the claimed method for forming an ohmic contact on a semiconductor layer comprising:

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- depositing a thin reactive layer 110 (thickness: 10~500 Å, col. 6, lines 15-18), by evaporation (col. 6, lines 38-46), comprising at least electrically conductive material (i.e. comprising Pt, Ni, Ru, Au, Co, col. 5, lines 57-59) on at least a portion of a compound semiconductor layer 803 (i.e. GaAs), 807, 806 (N+InGaAs); wherein the at least electrically conductive material is chosen from nickel (Fig.10 and col. 5, lines 57-59);
- depositing a refractory layer 111 (thickness: at least 100 Å or about 800 Å, col. 6, lines 30-34), by evaporation (col. 6, lines 38-46), comprising **titanium** (col. 6, lines 27-28) on the reactive layer 110, wherein said refractory layer 111 is substantially free of gold (col. 8, lines 6-8, Fig.11); and wherein additional layers of conductive metal are not deposited on the refractory layer 110 in the forming of the ohmic contact (Figs.12-13 and col. 8, lines 12-13); and wherein the ohmic contact is used in laser diode and a light emitting diode (col. 7, lines 40-54).

In re claims 21, 23, 27-28, 31-32, 45, 61, 66, Burton et al., in Figs, 3-5 and related text, expressly teach the claimed ohmic contact to a compound semiconductor layer comprising:

- a reactive layer 300 (thickness: 50~300 Å) comprising at least electrically conductive material choosing from Pt, Ni, Ru, Co (col. 4, lines 19-21) on at least a portion of a compound semiconductor layer 803 (i.e. GaAs), 807, 806 (N+InGaAs);
- a refractory layer 400 (Ti, thickness: 100~400 Å), wherein said refractory layer 400 is substantially free of gold (Fig.4); and
- a low sheet resistance layer 500 disposed upon the refractory layer 400 (Fig.5);

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wherein the ohmic contact is used in laser diode and a light emitting diode (col. 7, lines 40-54).

Claim Rejections - 35 USC § 103

9. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

10. Claims 3-5, 33 are rejected under 35 U.S.C. 103(a) as being unpatentable over Burton et al. (US '599) in view of Yagura et al. (US 6,188,137).

In re claims 3-5, Burton et al. teach that the compound semiconductor layer comprises $\text{In}_x\text{Ga}_{1-x}\text{As}$ but do not expressly teach that the x value is within the range of $0.05 < x < 1.00$ or $0.3 < x < 0.8$ or approximately 0.6.

However, Yagura et al in an analogous art teach utilizing N-type $\text{In}_x\text{Ga}_{1-x}\text{As}$ as the compound semiconductor layer, wherein the x value is within the range of $0.05 < x < 1.00$ or $0.3 < x < 0.8$ or approximately 0.6. (col.3, lines 55-56 and col. 4, line 12).

Therefore, it would have been obvious to one of the ordinary skill in the art, at the time the invention was made, to use the N-type $\text{In}_x\text{Ga}_{1-x}\text{As}$ having the specific x value, as taught by Yagura et al, in Burton's method for forming the ohmic contact, since by doing so it would provide a satisfactory ohmic contact structure with low contact resistance (col. 3, lines 14-18, Yagura et al.).

In re claim 33, the selection of the thickness of the refractory layer is obvious because it is a matter of determining optimum process condition by routine experimentation with a limited

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number of species. In re Jones, 162 USPQ 224 (CCPA 1955)(the selection of optimum ranges within prior art general conditions is obvious) and In re Boesch, 205 USPQ 215 (CCPA 1980)(discovery of optimum value of result effective variable in a known process is obvious).

For example, the thickness is a consideration of device dimension. In such a situation, the applicant must show that the particular range is critical, generally by showing that the claimed range achieves unexpected results relative to the prior art range. See M.P.E.P. 2144.05, III

11. Claims 9-11, 24-26, 35-40, 42, 44, 48, 62, 64, 68 are rejected under 35 U.S.C. 103(a) as being unpatentable over Burton et al. (US '599) in view of Jang et al. (US 6,169,297) and Yagura et al. (US '137).

In re claims 9, 10, 24, 25, 36, 44 and 48, Burton et al. do not teach that the thin reactive layer comprises an adhesive element.

However, Jang et al., in an analogous art of forming the ohmic contact, teach forming a metal film comprising Ni/Cr/Au (col. 1, lines 52-55 and col. 3, lines 1-5), wherein the component Cr acts as the adhesive element.

Therefore, it would have been obvious to one of ordinary skill in the art, at the time the invention was made, to comprise the adhesive element such as Cr in Ni as taught by Jang et al. in the reactive layer of Burton et al., since by doing so it would form a better ohmic contact.

In re claims 11, 26, 35 and 42, the selection of the atomic percentage of the adhesive element is obvious because it is a matter of determining optimum process condition by routine experimentation with a limited number of species. In re Jones, 162 USPQ 224 (CCPA 1955)(the selection of optimum ranges within prior art general conditions is obvious) and In re Boesch, 205 USPQ 215 (CCPA 1980)(discovery of optimum value of result effective variable in a known

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process is obvious). In such a situation, the applicant must show that the particular range is critical, generally by showing that the claimed range achieves unexpected results relative to the prior art range. See M.P.E.P. 2144.05, III

In re claims 37 and 68, Burton et al. in view of Jang et al. teach that the compound semiconductor layer comprises InGaAs, as stated above.

In re claims 38-40, Burton et al. in view of Jang et al. and Yagura et al. teach that $\text{In}_x\text{Ga}_{1-x}\text{As}$, wherein $0.3 < x < 0.8$, as stated above.

In re claims 62 and 64, Burton et al. teach depositing a low resistance layer 500 onto the refractory layer 400, as stated above.

12. Claims 6 and 41 are rejected under 35 U.S.C. 103(a) as being unpatentable over Burton et al. (US '599) in view of Jang et al. (US '297) and further in view of Uchibori et al. (US 5,982,036).

In re claims 6 and 41, Burton et al. in view of Jang et al. teach the claimed method for forming the ohmic contact on the compound semiconductor layer comprising InGaAs but fail to teach the compound semiconductor layer comprising InAs.

However, Uchibori et al in an analogous art teach forming a multi-layered structure 306/305/304 as the ohmic contact on the InAs layer 303, wherein the multi-layered structure 306/305/304 comprising a Ni film (304), which is formed on the InAs layer 303 (Figs. 4A-4D).

Therefore, it would have been obvious to one of the ordinary skill in the art, at the time the invention was made, to use the InAs as the compound semiconductor layer as taught by Uchibori et al in Burton et al. in view of Jang et al so that the reactive layer of Burton et al. can be formed on the InAs layer, since by this manner it would benefit the subsequent annealing

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processing step (col. 8, lines 1-12, Uchibori et al) and obtain the ohmic contact with low contact resistance (Fig. 5, Uchibori et al).

In re claims 14-18 and 29-33, the selection of the thickness of the reactive layer as well as the refractory layer is obvious because it is a matter of determining optimum process condition by routine experimentation. In re Jones, 162 USPQ 224 (CCPA 1955)(the selection of optimum ranges within prior art general conditions is obvious) and In re Boesch, 205 USPQ 215 (CCPA 1980)(discovery of optimum value of result effective variable in a known process is obvious). In such a situation, applicants must show that the particular range is critical, generally by showing that the claimed thickness achieves unexpected results. See M.P.E.P. 2144.05 III. In this regard, the as-filed specification does not demonstrate any criticality regarding the claimed thickness range (refers to specification on page 6, lines 11-12).

In re claims 11 and 26, the selection of the atomic percent of the adhesive element is obvious because it is a matter of determining optimum process condition by routine experimentation. In re Jones, 162 USPQ 224 (CCPA 1955)(the selection of optimum ranges within prior art general conditions is obvious) and In re Boesch, 205 USPQ 215 (CCPA 1980)(discovery of optimum value of result effective variable in a known process is obvious). In such a situation, applicants must show that the particular range is critical, generally by showing that the claimed thickness achieves unexpected results. See M.P.E.P. 2144.05 III. In this regard, the originally filed specification does not demonstrate any criticality regarding the claimed range.

13. Claims 49-60 are rejected under 35 U.S.C. 103(a) as being unpatentable over Burton et al. (US '599) in view of Jang et al. (US '297) and further in view of Maiti et al. (US 6,049,114)

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In re claims 49, 52, 55 and 58, Burton et al. in view of Jang et al. substantially teach the claimed ohmic contact and method, as stated above, but fail to teach forming a dielectric layer disposed upon the refractory layer.

However, Maiti et al. , in an analogous art, teach forming a dielectric layer 16 (i.e. nitride) disposed upon the refractory layer 14 (e.g. Ti, col. 3, lines 9-11 and Fig.10).

Therefore, it would have been obvious to one of the ordinary skill in the art at the time the invention was made to form the dielectric layer disposed upon the refractory layer, as taught by Maiti et al., in forming the ohmic contact of Burton et al. in view of Jang et al., since by this manner it would provide a protection for underlying layers.

In re claims 50, 53, 56 and 59, Burton et al. in view of Jang et al. fail to teach forming a nitride liner onto a portion of the dielectric layer.

However, Maiti et al. , in an analogous art, teach forming a nitride liner 22 onto a portion of the dielectric layer 16 (Fig.10).

Therefore, it would have been obvious to one of the ordinary skill in the art at the time the invention was made to form the nitride liner onto the dielectric layer, as taught by Maiti et al., in forming the ohmic contact of Burton et al. in view of Jang et al., since by this manner it would provide a protection for subsequent processing, such as ion implantations.

In re claims 51, 54, 57 and 60, Burton et al. in view of Jang et al. fail to teach depositing a spacer onto the nitride liner.

However, Maiti et al. , in an analogous art, teach depositing a spacer 30 onto the nitride liner 22 (Fig.10).

Therefore, it would have been obvious to one of the ordinary skill in the art at the time the invention was made to despitte the spacer onto the nitride liner, as taught by Maiti et al., in forming the ohmic contact of Burton et al. in view of Jang et al., since by this manner it would provide a double protection for subsequent processing, such as ion implantations.

Double Patenting

14. Claims 29 and 30 are objected to under 37 CFR 1.75 as being a substantial duplicate of claims 14 and 15, respectively. Claim 64 is objected to under 37 CFR 1.75 as being a substantial duplicate of claim 62. When two claims in an application are duplicates or else are so close in content that they both cover the same thing, despite a slight difference in wording, it is proper after allowing one claim to object to the other as being a substantial duplicate of the allowed claim. See MPEP § 706.03(k).

15. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Hsien-Ming Lee whose telephone number is 703-305-7341. The examiner can normally be reached on M-F (9:00 ~ 5:00).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri can be reached on 703-306-2794. The fax phone numbers for the organization where this application or proceeding is assigned are 703-308-7722 for regular communications and 703-308-7722 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.

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Hsien-Ming Lee
Examiner
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A handwritten signature in black ink, appearing to read 'Lee', with a long horizontal flourish extending to the right.

July 22, 2003